

EMC Basics



more
than you
expect

Speaker : Alain Lafuente

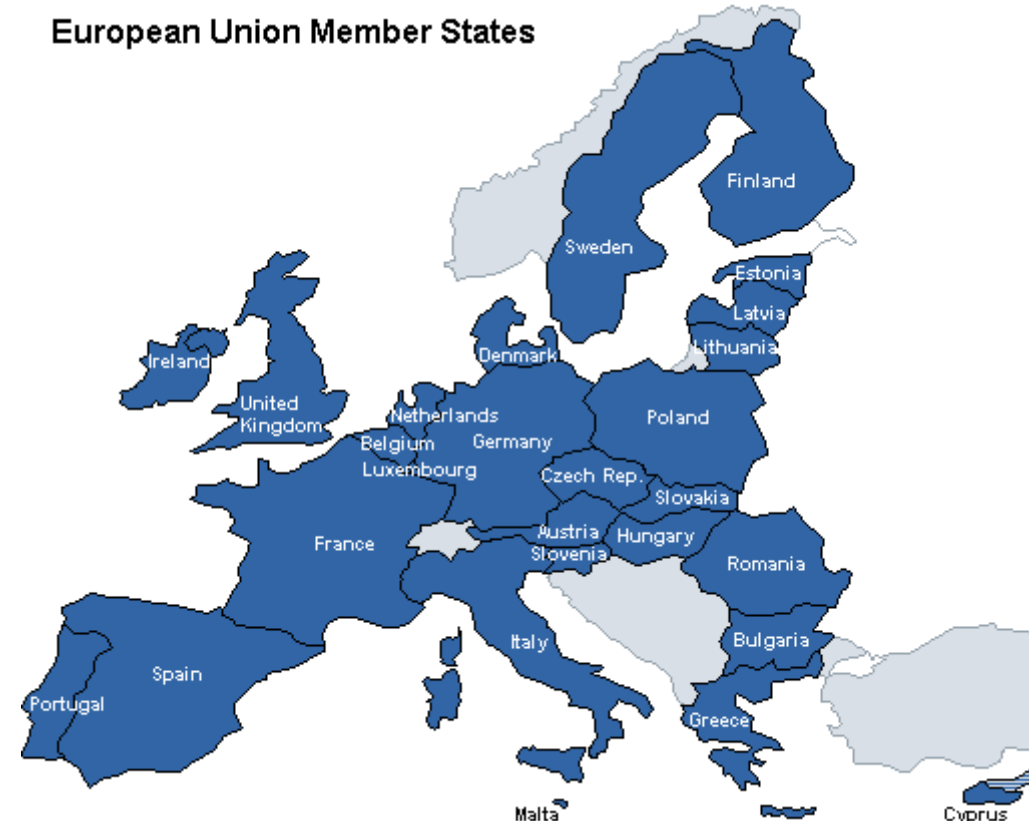
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WHAT IS EMC?

CE Marking

- With the formation of the single European market, standardization was required to remove technical barriers to trade.
- New Approach Directives were introduced to remove these barriers to trade
- 22 New Approach Directives
 - Electro Magnetic Compatibility (EMC)**
 - Low Voltage Directive (LVD)**
 - Medical Devices Directive (MDD)**



What's all the fuss about EMC?

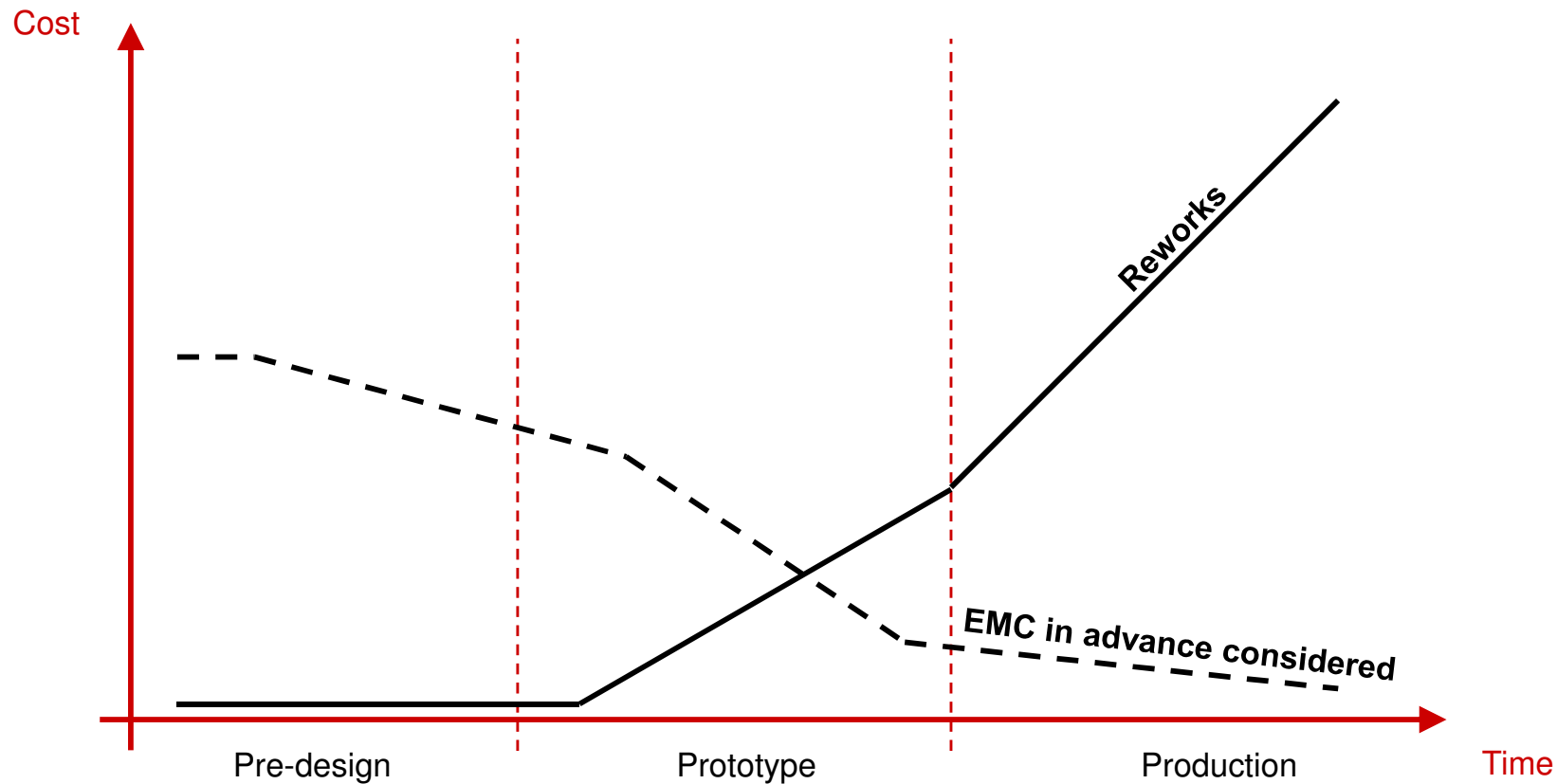
- In Europe, we have a mechanism called CE Marking
- It is applicable to any electrical/electronic product
- **EMC Directive**, regulation to ensure that intentional RF transmission signals are not interfered with
- Ensures that Electrical/Electronic devices continue to operate as intended in a Electro Magnetic Environment
- Failure to comply with the law can be a offence, either criminal, civil or both



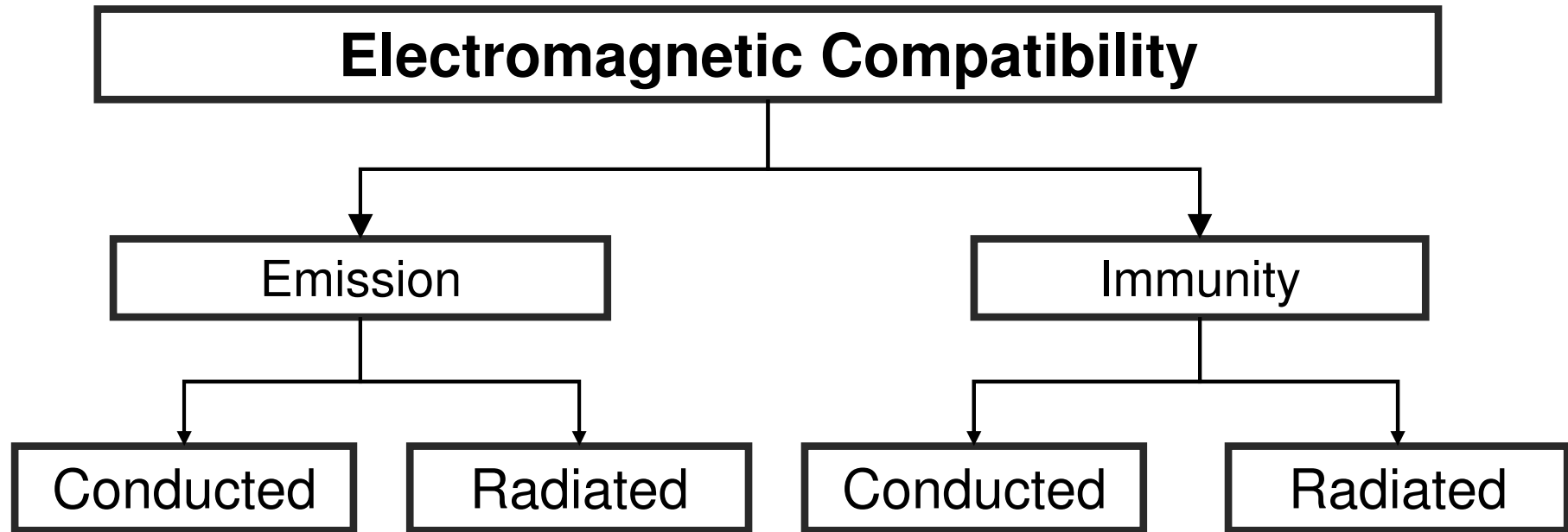
EMC Effect

Economical point of view:

- dependent on when EMC conformity is considered in a design phase

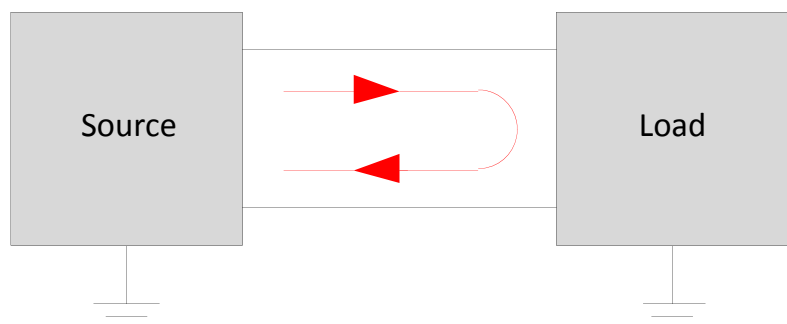


EMC – Basic Phenomena



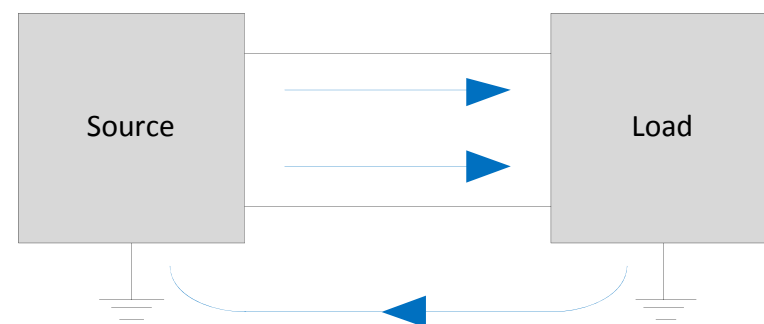
Filter and Signal – Common Mode Filter

differential mode



- Source transmits noise in differential mode
- Differential mode noise is transmitted via conductive paths
- Transmitting paths are power supply or data lines
- “earth” is not affected by noise

common mode



- Load is disturbed by common mode noise
- Noise flow from source to load. The return path is over “earth”
- Transmitting paths are power supply or data lines
- “earth” is affected by noise

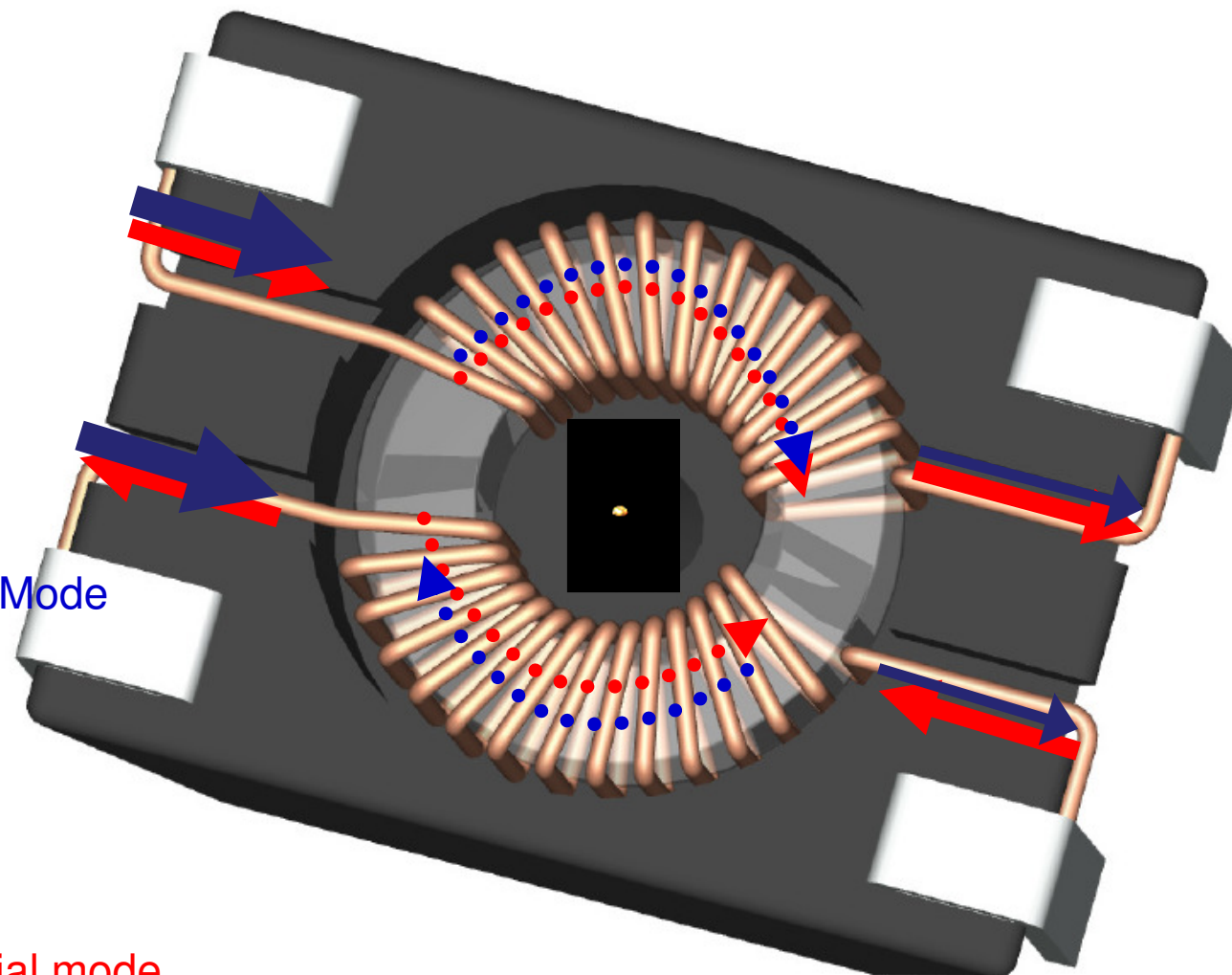
Common Mode Filter – How it works

It is a Bi-directional filter

- From device to outside environment
- From outside environment to inside device

Intended Signal - **Differential mode**

Interference Signal (noise) – **Common Mode**



Conclusion:

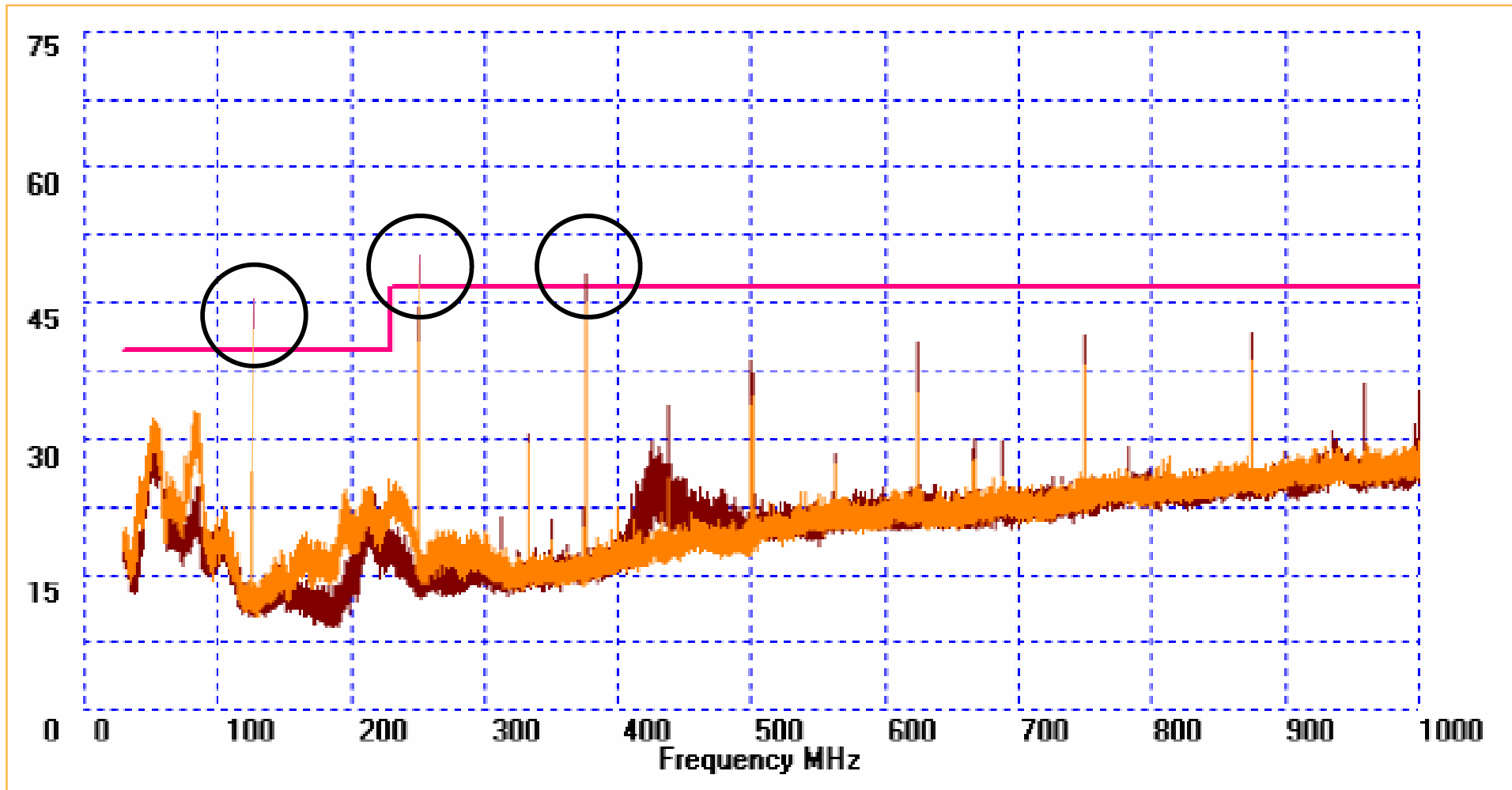
- “almost” no affect the signal - **Differential mode**
- high attenuation to the interference signal (noise) – **Common Mode**



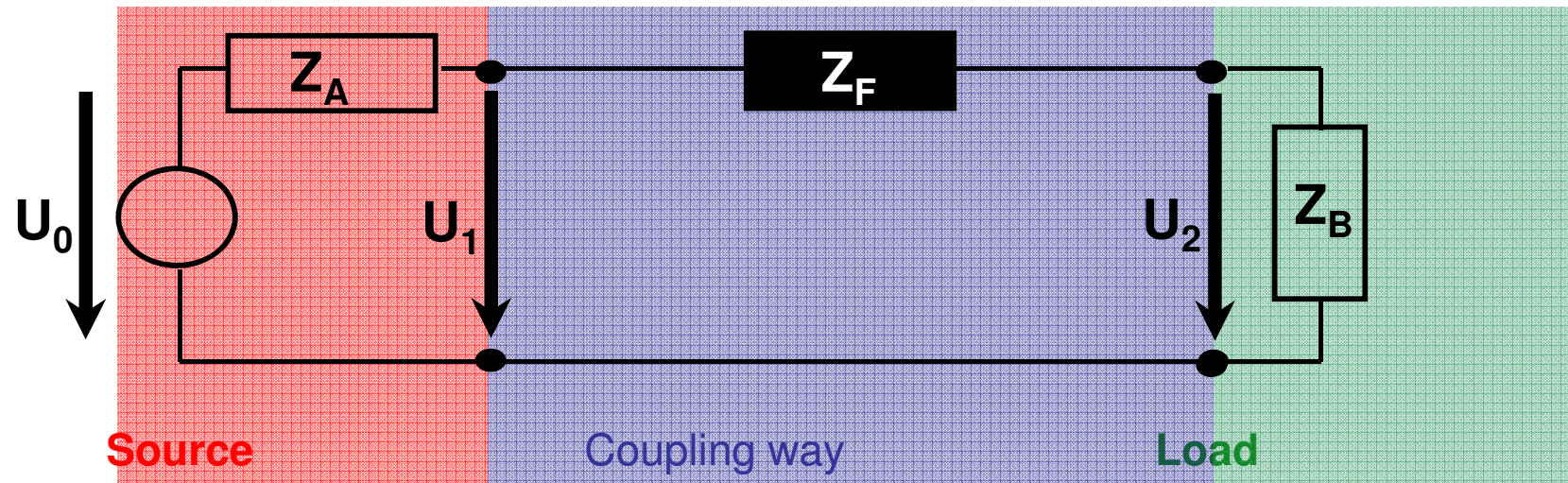
INSERTION LOSS

The problem

- Example, Radiated Emission plot



Insertion Loss – Definition



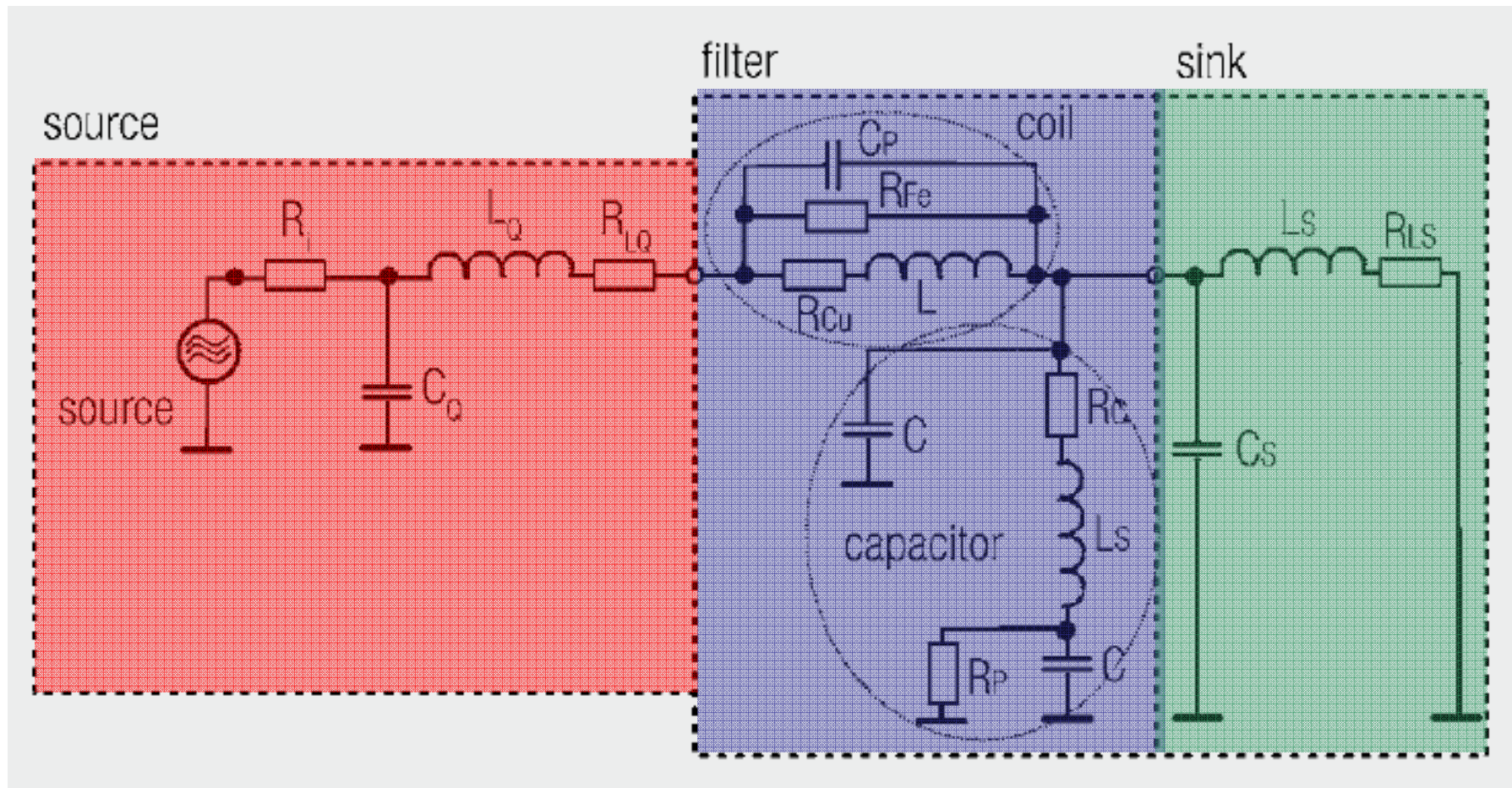
- System attenuation

$$A = 20 \cdot \log \frac{Z_A + Z_F + Z_B}{Z_A + Z_B} \quad \text{in (dB)}$$
- Impedance

$$Z_F = \left[10^{\frac{A}{20}} \cdot (Z_A + Z_B) \right] - (Z_A + Z_B) \quad \text{in } (\Omega)$$

Insertion loss

- The real world – equivalent circuit

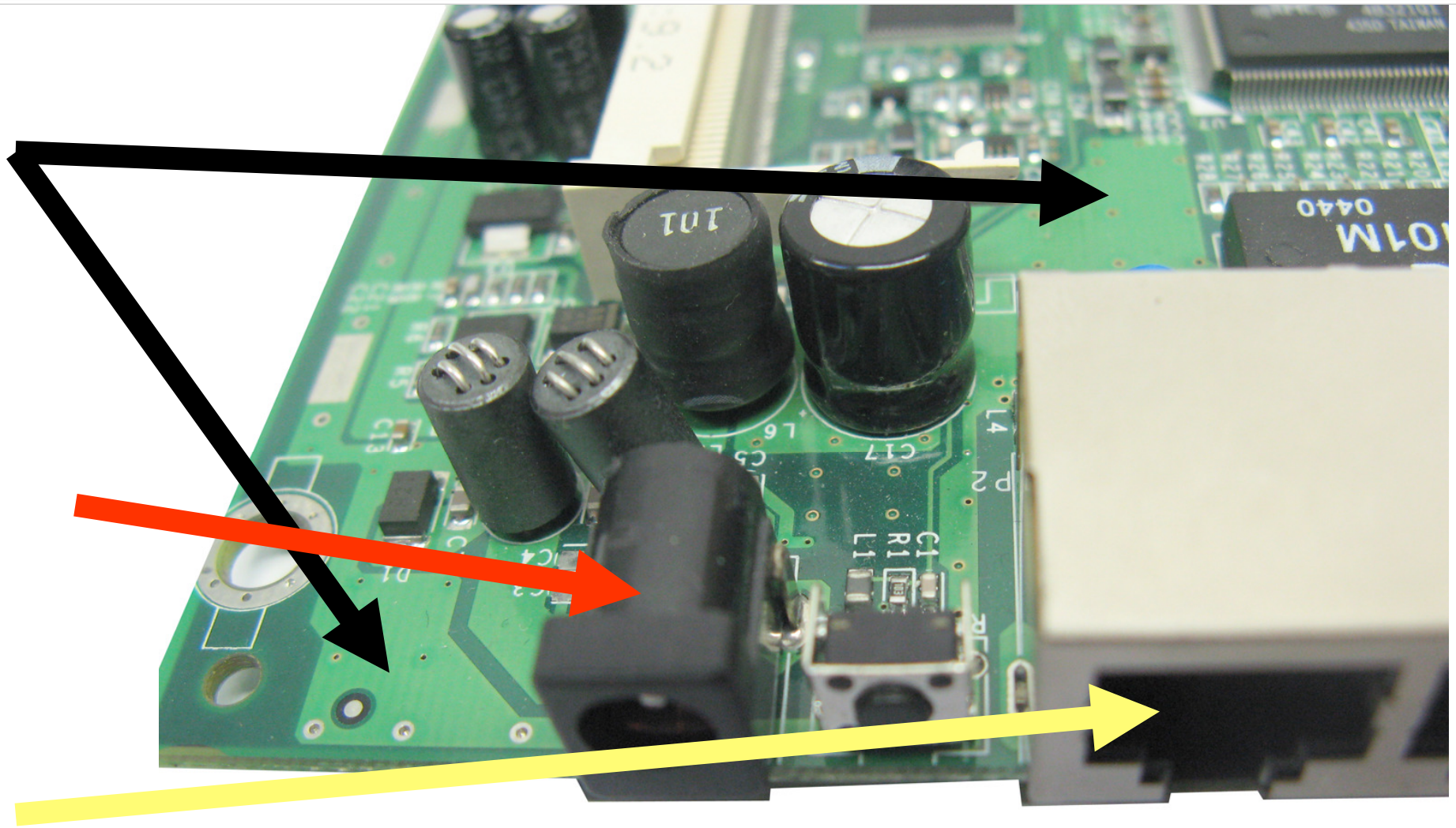


System impedances

1 Ω

10 Ω

>90 Ω



The mathematical approach

$$Z_F = \left[10^{\frac{A}{20}} \cdot (Z_A + Z_B) \right] - (Z_A + Z_B)$$

$$Z_F = \left[10^{\frac{20}{20}} \cdot (10_A + 10_B) \right] - (10_A + 10_B)$$

$$Z_F = 180 \Omega$$

1. Require 20dB of attenuation at 200 MHz
2. Know that it is a power cable
3. Power port has 10 Ω impedance
4. Result is a impedance of 180 Ω

$$A = 20 \log \frac{Z_A + Z_F + Z_B}{Z_A + Z_B}$$

$$A = 20 \log \frac{10_A + 180_F + 10_B}{10_A + 10_B}$$

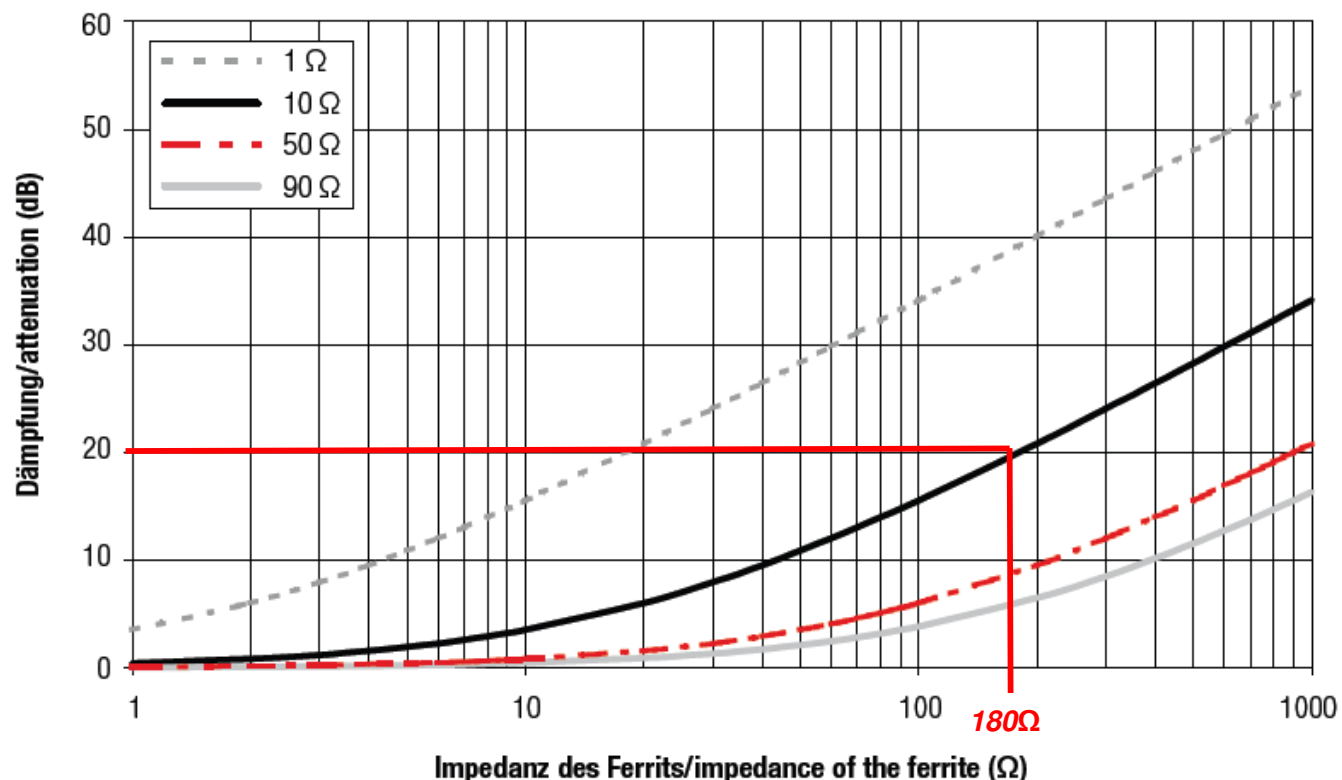
$$A = 20 \log 10$$

$$A = 20.00 \text{ dB}$$

Application overview

Assumed practical system impedance	Application
1 Ω	GND (Ground Planes)
10 Ω	V _{cc} (Supply Voltage lines)
50 Ω – 90 Ω	Datasignal Lines/Clock/ Video Signal/USB
90 Ω – 150 Ω	Long Datasignal Lines

The practical approach



Application overview	
Assumend practical system impedance	Application
1 Ω	GND (Ground Planes)
10 Ω	V _{cc} (Supply Voltage lines)
50 Ω – 90 Ω	Datasignal Lines/Clock/Video Signal/USB
90 Ω – 150 Ω	Long Datasignal Lines

1. Require 20dB of attenuation at 200 MHz
2. Know that it is a power cable
3. Power port has 10 Ω impedance
4. Result is a impedance of 180Ω

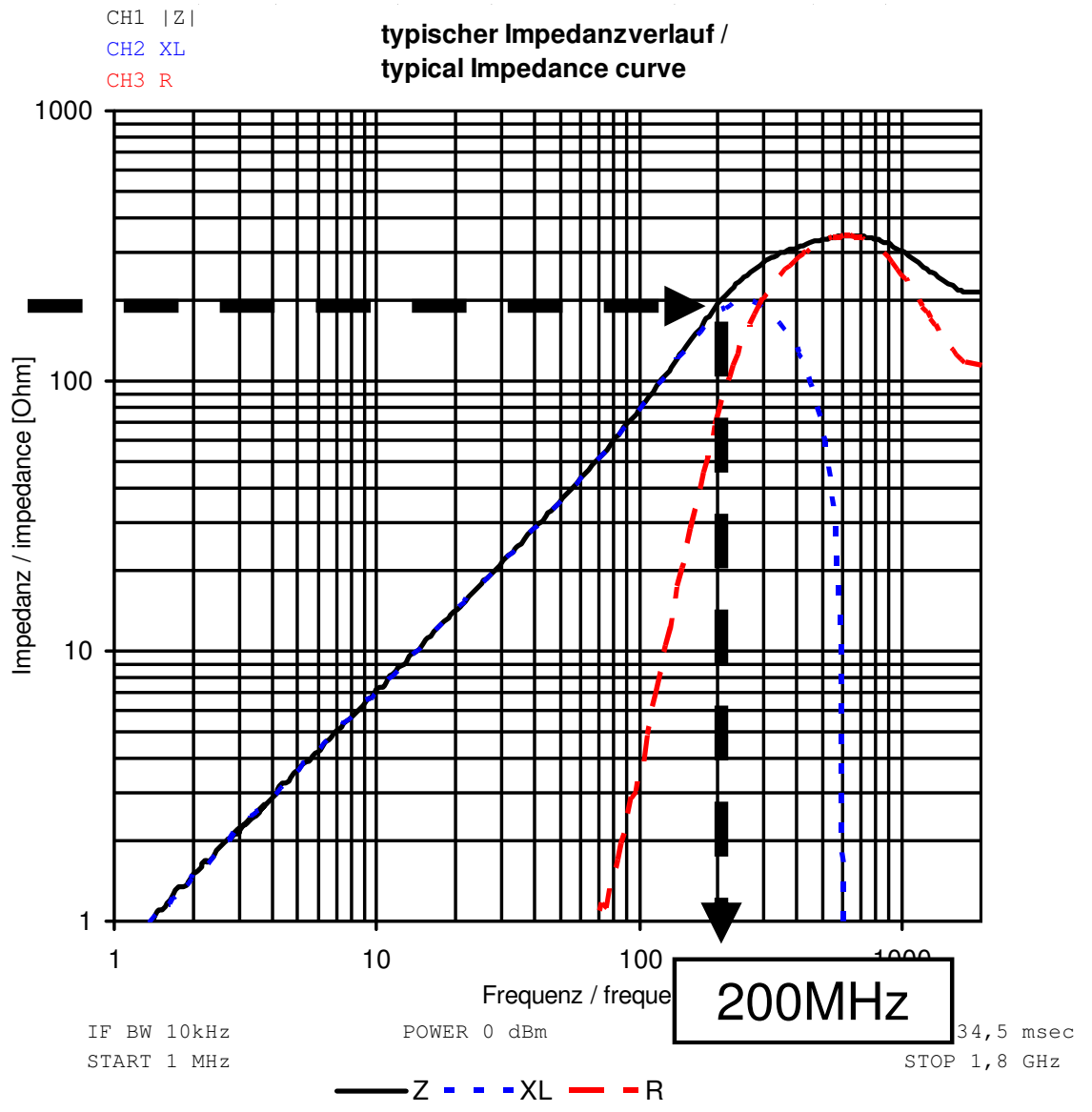




Insertion loss – Example

- WE-CBF 742 792 61

200Ω





Component selector

File Tools Window Help

EMC Components	Power Products	Signal & Communications
 Ferrites for PCB Assembly	 Power Inductors	 Signal & Backlight LED
 Ferrites for Cable Assembly	 Flexible Transformer for SMPS	 RF Inductors
 Common Mode Chokes	 PFC Chokes	 RJ45 LAN Transformer
		 LAN Transformer



Component selector

File Tools Window Help

Parameter
 Source Impedance = -
 Sink Impedance = -
 Frequency = -
 Attenuation = -
 Needed Impedance = -

Settings

Series	Type	Size	Order Code	Impedance @ Freq	Zmax @ Freq	RDC	IDC	Length	Width	Height	Lines	Assembling Technology
<input type="checkbox"/> WE-CBF	High Speed	0805	7427920	11,0 Ω @ 100,0 MHz	24,0 Ω @ 1,0 GHz	150,0 mΩ	600,0 mA	2,0 mm	1,3 mm	0,9 mm	1,0	SMT
<input type="checkbox"/> WE-CBF	High Speed	0805	742792005	5,0 Ω @ 100,0 MHz	18,0 Ω @ 1,0 GHz	70,0 mΩ	700,0 mA	2,0 mm	1,3 mm	0,9 mm	1,0	SMT
<input type="checkbox"/> WE-CBF	High Speed	0805	74279201	32,0 Ω @ 100,0 MHz	70,0 Ω @ 1,0 GHz	150,0 mΩ	500,0 mA	2,0 mm	1,3 mm	0,9 mm	1,0	SMT
<input type="checkbox"/> WE-CBF	High Current	0805	742792010	7,0 Ω @ 100,0 MHz	11,0 Ω @ 1,0 GHz	30,0 mΩ	3,0 A	2,0 mm	1,3 mm	0,9 mm	1,0	SMT
<input type="checkbox"/> WE-CBF	High Current	0805	742792011	10,0 Ω @ 100,0 MHz	20,0 Ω @ 1,0 GHz	25,0 mΩ	3,0 A	2,0 mm	1,3 mm	0,9 mm	1,0	SMT
<input type="checkbox"/> WE-CBF	High Current	0805	742792012	33,0 Ω @ 100,0 MHz	58,0 Ω @ 800,0 MHz	8,0 mΩ	4,0 A	2,0 mm	1,3 mm	0,9 mm	1,0	SMT
<input type="checkbox"/> WE-CBF	High Speed	0805	742792015	56,0 Ω @ 100,0 MHz	230,0 Ω @ 800,0 MHz	300,0 mΩ	300,0 mA	2,0 mm	1,3 mm	0,9 mm	1,0	SMT
<input type="checkbox"/> WE-CBF	High Current	0805	742792017	90,0 Ω @ 100,0 MHz	120,0 Ω @ 400,0 MHz	20,0 mΩ	5,0 A	2,0 mm	1,3 mm	0,9 mm	1,0	SMT
<input type="checkbox"/> WE-CBF	High Speed	0805	74279202	120,0 Ω @ 100,0 MHz	200,0 Ω @ 400,0 MHz	100,0 mΩ	500,0 mA	2,0 mm	1,3 mm	0,9 mm	1,0	SMT
<input type="checkbox"/> WE-CBF	High Current	0805	742792021	22,0 Ω @ 100,0 MHz	40,0 Ω @ 1,0 GHz	8,0 mΩ	6,0 A	2,0 mm	1,3 mm	0,9 mm	1,0	SMT
<input type="checkbox"/> WE-CBF	High Current	0805	742792022	220,0 Ω @ 100,0 MHz	330,0 Ω @ 300,0 MHz	50,0 mΩ	2,0 A	2,0 mm	1,3 mm	0,9 mm	1,0	SMT
<input type="checkbox"/> WE-CBF	High Current									0,9 mm	1,0	SMT
<input type="checkbox"/> WE-CBF	High Speed									0,9 mm	1,0	SMT
<input type="checkbox"/> WE-CBF	High Current									0,9 mm	1,0	SMT
<input type="checkbox"/> WE-CBF	High Current									0,9 mm	1,0	SMT
<input type="checkbox"/> WE-CBF	Wide Band									0,9 mm	1,0	SMT
<input type="checkbox"/> WE-CBF	High Speed									0,9 mm	1,0	SMT
<input type="checkbox"/> WE-CBF	High Speed									0,9 mm	1,0	SMT
<input type="checkbox"/> WE-CBF	Wide Band									0,9 mm	1,0	SMT

Tip: Right-click with mouse on column

add filter remove filter select all deselect

Settings

Application Overview
 Ground Planes: 1-2 Ω
 VCC Distribution: 10-20 Ω
 Video, Clock, Dataline: 50-90 Ω
 Long Data Lines: 90-150 Ω

+ apply reject

✗ abort

Source Impedance 10 Ω Attenuation 20 dB
 Sink Impedance 10 Ω Frequency 200 MHz

Impedance (Ohm)

10¹

10⁰

10⁻¹

10⁻¹ 10⁰ 10¹

Frequency (MHz)

Please select an item

Inductive Reactance

10⁰

10⁻¹

10⁻¹ 10⁰ 10¹

Frequency (MHz)

Please select an item

Resistance (Ohm)

10⁰

10⁻¹

10⁻¹ 10⁰ 10¹

Frequency (MHz)

Please select an item



Component selector

File Tools Window Help

Parameter
 Source Impedance = 10 Ω
 Sink Impedance = 10 Ω
 Frequency = 200 MHz
 Attenuation = 20 dB
 Needed Impedance = 180 Ω

Settings

Series	Type	Size	Order Code	Impedance @ Freq	Zmax @ Freq	RDC	IDC	Length	Width	Height	Lines	Assembling Technology
<input type="checkbox"/> WE-CBF	High Current	0805	742792022	220,0 Ω @ 100,0 MHz	330,0 Ω @ 300,0 MHz	50,0 mΩ	2,0 A	2,0 mm	1,3 mm	0,9 mm	1,0	SMT
<input type="checkbox"/> WE-CBF	High Speed	0805	74279203	150,0 Ω @ 100,0 MHz	250,0 Ω @ 400,0 MHz	250,0 mΩ	300,0 mA	2,0 mm	1,3 mm	0,9 mm	1,0	SMT
<input type="checkbox"/> WE-CBF	High Current	0805	742792031	300,0 Ω @ 100,0 MHz	350,0 Ω @ 200,0 MHz	50,0 mΩ	3,0 A	2,0 mm	1,3 mm	0,9 mm	1,0	SMT
<input type="checkbox"/> WE-CBF	Wide Band	0805	742792032	400,0 Ω @ 100,0 MHz	500,0 Ω @ 200,0 MHz	300,0 mΩ	300,0 mA	2,0 mm	1,3 mm	0,9 mm	1,0	SMT
<input type="checkbox"/> WE-CBF	High Speed	0805	742792034	220,0 Ω @ 100,0 MHz	300,0 Ω @ 240,0 MHz	300,0 mΩ	300,0 mA	2,0 mm	1,3 mm	0,9 mm	1,0	SMT
<input type="checkbox"/> WE-CBF	High Speed	0805	742792035	300,0 Ω @ 100,0 MHz	450,0 Ω @ 220,0 MHz	300,0 mΩ	300,0 mA	2,0 mm	1,3 mm	0,9 mm	1,0	SMT
<input type="checkbox"/> WE-CBF	Wide Band	0805	742792036	470,0 Ω @ 100,0 MHz	560,0 Ω @ 190,0 MHz	300,0 mΩ	200,0 mA	2,0 mm	1,3 mm	0,9 mm	1,0	SMT
<input type="checkbox"/> WE-CBF	High Current	0805	742792037	330,0 Ω @ 100,0 MHz	375,0 Ω @ 250,0 MHz	80,0 mΩ	2,0 A	2,0 mm	1,3 mm	0,9 mm	1,0	SMT
<input type="checkbox"/> WE-CBF	Wide Band	0805	742792038	240,0 Ω @ 100,0 MHz	280,0 Ω @ 250,0 MHz	400,0 mΩ	200,0 mA	2,0 mm	1,3 mm	0,9 mm	1,0	SMT
<input type="checkbox"/> WE-CBF	Wide Band	0805	74279204	600,0 Ω @ 100,0 MHz	700,0 Ω @ 150,0 MHz	350,0 mΩ	200,0 mA	2,0 mm	1,3 mm	0,9 mm	1,0	SMT
<input type="checkbox"/> WE-CBF	High Current	0805	742792040	600,0 Ω @ 100,0 MHz			2,0 A	2,0 mm	1,3 mm	0,9 mm	1,0	SMT
<input type="checkbox"/> WE-CBF	Wide Band	0805	742792041	600,0 Ω @ 100,0 MHz			200,0 mA	2,0 mm	1,3 mm	0,9 mm	1,0	SMT
<input type="checkbox"/> WE-CBF	Wide Band	0805	7427920415	600,0 Ω @ 100,0 MHz			500,0 mA	2,0 mm	1,3 mm	0,9 mm	1,0	SMT
<input type="checkbox"/> WE-CBF	High Speed	0805	742792042	600,0 Ω @ 100,0 MHz			200,0 mA	2,0 mm	1,3 mm	0,9 mm	1,0	SMT
<input type="checkbox"/> WE-CBF	High Speed	0805	742792043	600,0 Ω @ 100,0 MHz			200,0 mA	2,0 mm	1,3 mm	0,9 mm	1,0	SMT
<input type="checkbox"/> WE-CBF	High Speed	0805	742792045	750,0 Ω @ 100,0 MHz			200,0 mA	2,0 mm	1,3 mm	0,9 mm	1,0	SMT
<input type="checkbox"/> WE-CBF	Wide Band	0805	74279205	1,0 kΩ @ 100,0 MHz			200,0 mA	2,0 mm	1,3 mm	0,9 mm	1,0	SMT
<input type="checkbox"/> WE-CBF	High Speed	0805	742792064	75,0 Ω @ 100,0 MHz			300,0 mA	2,0 mm	1,3 mm	0,9 mm	1,0	SMT

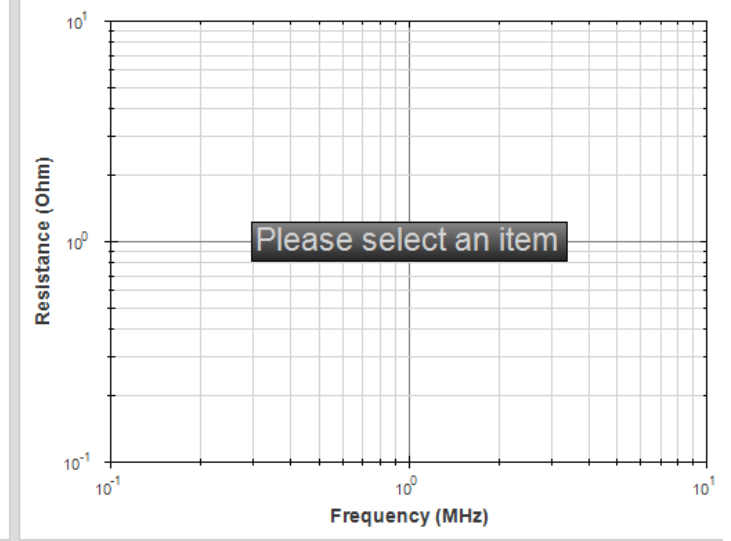
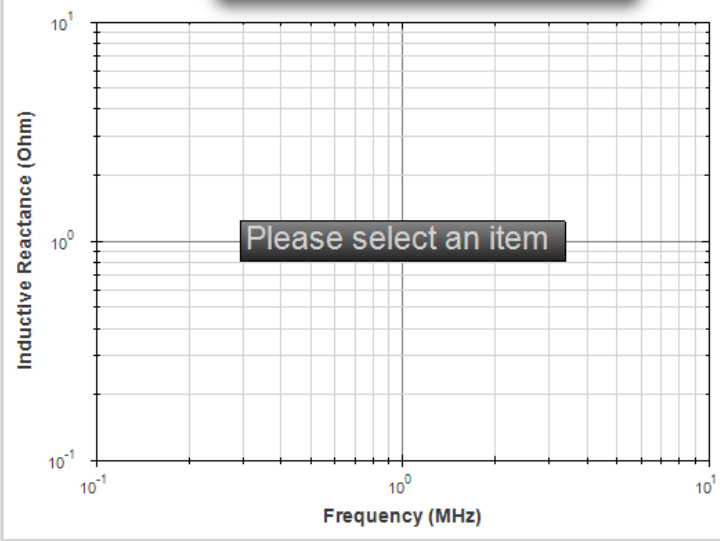
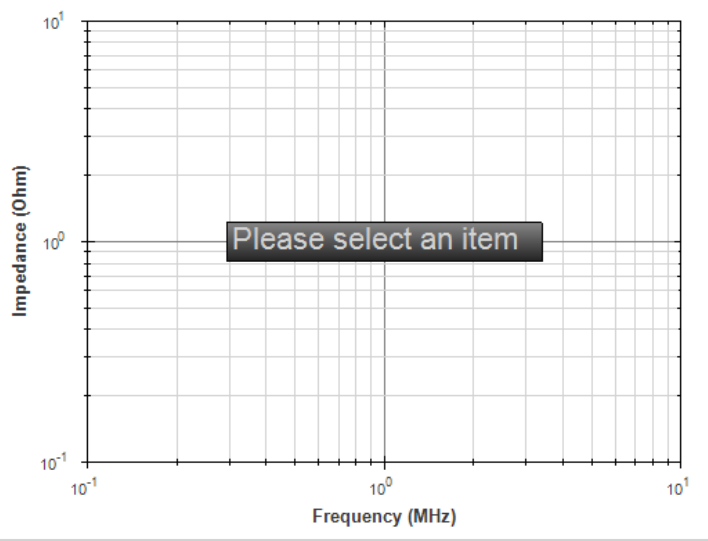
Tip: Right-click with mouse on column-header for filtering components.

add filter remove filter select all deselect all add own Frequency

Size - Filter

0201
 0402
 0603
 0805
 11046
 1111
 1206
 1280
 1806
 1812
 2220

+ apply
 remove
 X abort





Component selector

File Tools Window Help

Parameter

Source Impedance = 10 Ω
Sink Impedance = 10 Ω
Frequency = 200 MHz
Attenuation = 20 dB
Needed Impedance = 180 Ω

Settings

Series	Type	Size	Order Code	Impedance @ Freq	Zmax @ Freq	RDC	IDC	Length	Width	Height	Lines	Assembling Technology
<input type="checkbox"/> WE-CBF	High Current	0805	742792022	220,0 Ω @ 100,0 MHz	330,0 Ω @ 300,0 MHz	50,0 mΩ	2,0 A	2,0 mm	1,3 mm	0,9 mm	1,0	SMT
<input type="checkbox"/> WE-CBF	High Current	0805	742792031	300,0 Ω @ 100,0 MHz	350,0 Ω @ 200,0 MHz	50,0 mΩ	3,0 A	2,0 mm	1,3 mm	0,9 mm	1,0	SMT
<input type="checkbox"/> WE-CBF	High Current	0805	742792037	330,0 Ω @ 100,0 MHz	375,0 Ω @ 250,0 MHz	80,0 mΩ	2,0 A					
<input type="checkbox"/> WE-CBF	High Current	0805	742792040	600,0 Ω @ 100,0 MHz	700,0 Ω @ 150,0 MHz	150,0 mΩ	2,0 A					
<input type="checkbox"/> WE-CBF	Wide Band	0805	7427920415	600,0 Ω @ 100,0 MHz	660,0 Ω @ 150,0 MHz	300,0 mΩ	500,0 mA					
<input type="checkbox"/> WE-CBF	High Current	0805	742792096	1,0 kΩ @ 100,0 MHz	1,0 kΩ @ 100,0 MHz	300,0 mΩ	1,0 A					
<input type="checkbox"/> WE-CBF	High Current	0805	742792097	1,5 kΩ @ 100,0 MHz	1,8 kΩ @ 70,0 MHz	300,0 mΩ	1,0 A					
<input type="checkbox"/> WE-CBF	High Current	1206	742792116	500,0 Ω @ 100,0 MHz	610,0 Ω @ 150,0 MHz	60,0 mΩ	2,5 A					
<input type="checkbox"/> WE-CBF	High Current	1206	742792121	300,0 Ω @ 100,0 MHz	330,0 Ω @ 110,0 MHz	60,0 mΩ	3,0 A					
<input type="checkbox"/> WE-CBF	High Current	1206	742792141	1,0 kΩ @ 100,0 MHz	1,1 kΩ @ 90,0 MHz	300,0 mΩ	1,0 A					
<input type="checkbox"/> WE-CBF	High Current	1206	74279218	600,0 Ω @ 100,0 MHz	700,0 Ω @ 90,0 MHz	100,0 mΩ	2,0 A					
<input type="checkbox"/> WE-CBF	High Current	1206	742792118	600,0 Ω @ 100,0 MHz	650,0 Ω @ 80,0 MHz	70,0 mΩ	2,5 A					
<input type="checkbox"/> WE-CBF	High Speed	1206	742792133	600,0 Ω @ 100,0 MHz	750,0 Ω @ 60,0 MHz	300,0 mΩ	500,0 mA	3,2 mm	1,6 mm	1,1 mm	1,0	SMT
<input type="checkbox"/> WE-CBF	High Speed	0603	742792621	140,0 Ω @ 100,0 MHz	430,0 Ω @ 550,0 MHz	200,0 mΩ	550,0 mA	1,6 mm	0,8 mm	0,8 mm	1,0	SMT
<input type="checkbox"/> WE-CBF	Wide Band	0603	742792622	180,0 Ω @ 100,0 MHz	290,0 Ω @ 380,0 MHz	300,0 mΩ	500,0 mA	1,6 mm	0,8 mm	0,8 mm	1,0	SMT
<input type="checkbox"/> WE-CBF	Wide Band	0603	74279263	220,0 Ω @ 100,0 MHz	280,0 Ω @ 350,0 MHz	300,0 mΩ	500,0 mA	1,6 mm	0,8 mm	0,8 mm	1,0	SMT
<input type="checkbox"/> WE-CBF	High Current	0603	742792641	300,0 Ω @ 100,0 MHz	450,0 Ω @ 250,0 MHz	150,0 mΩ	2,0 A	1,6 mm	0,8 mm	0,8 mm	1,0	SMT
<input type="checkbox"/> WE-CBF	High Current	0603	742792651	600,0 Ω @ 100,0 MHz	800,0 Ω @ 200,0 MHz	200,0 mΩ	1,0 A	1,6 mm	0,8 mm	0,8 mm	1,0	SMT

frequency minimum maximum

Tip: Right-click with mouse on column-header for filtering components.

add filter remove filter select all deselect all add own Frequency

Impedance (Ohm)

Frequency (MHz)

Inductive Reactance (Ohm)

Frequency (MHz)

Resistance (Ohm)

Frequency (MHz)



Component selector

File Tools Window Help

Parameter
 Source Impedance = 10 Ω
 Sink Impedance = 10 Ω
 Frequency = 200 MHz
 Attenuation = 20 dB
 Needed Impedance = 180 Ω

frequency minimum maximum

Series	Type	Size	Order Code	Impedance @ Freq	Zmax @ Freq	RDC	IDC	Length	Width	Height	Lines	Assembling Technology
<input type="checkbox"/> WE-CBF	High Current	0805	742792022	220,0 Ω @ 100,0 MHz	330,0 Ω @ 300,0 MHz	50,0 mΩ	2,0 A	2,0 mm	1,3 mm	0,9 mm	1,0	SMT
<input type="checkbox"/> WE-CBF	High Current	0805	742792031	300,0 Ω @ 100,0 MHz	350,0 Ω @ 200,0 MHz	50,0 mΩ	3,0 A	2,0 mm	1,3 mm	0,9 mm	1,0	SMT
<input type="checkbox"/> WE-CBF	High Current	0805	742792037	330,0 Ω @ 100,0 MHz	375,0 Ω @ 250,0 MHz	80,0 mΩ	2,0 A	2,0 mm	1,3 mm	0,9 mm	1,0	SMT
<input type="checkbox"/> WE-CBF	High Current	0805	742792040	600,0 Ω @ 100,0 MHz	700,0 Ω @ 150,0 MHz	150,0 mΩ	2,0 A	2,0 mm	1,3 mm	0,9 mm	1,0	SMT
<input type="checkbox"/> WE-CBF	Wide Band	0805	7427920415	600,0 Ω @ 100,0 MHz	660,0 Ω @ 150,0 MHz	300,0 mΩ	500,0 mA	2,0 mm	1,3 mm	0,9 mm	1,0	SMT
<input type="checkbox"/> WE-CBF	High Current	0805	742792096	1,0 kΩ @ 100,0 MHz	1,0 kΩ @ 100,0 MHz	300,0 mΩ	1,0 A	2,0 mm	1,3 mm	0,9 mm	1,0	SMT
<input type="checkbox"/> WE-CBF	High Current	0805	742792097	1,5 kΩ @ 100,0 MHz	1,8 kΩ @ 70,0 MHz	300,0 mΩ	1,0 A	2,0 mm	1,3 mm	0,9 mm	1,0	SMT
<input type="checkbox"/> WE-CBF	High Current	1206	742792116	500,0 Ω @ 100,0 MHz	610,0 Ω @ 150,0 MHz	60,0 mΩ	2,5 A	3,2 mm	1,6 mm	1,1 mm	1,0	SMT
<input type="checkbox"/> WE-CBF	High Current	1206	742792121	300,0 Ω @ 100,0 MHz	330,0 Ω @ 110,0 MHz	60,0 mΩ	3,0 A	3,2 mm	1,6 mm	1,1 mm	1,0	SMT
<input type="checkbox"/> WE-CBF	High Current	1206	742792141	1,0 kΩ @ 100,0 MHz	1,1 kΩ @ 90,0 MHz	300,0 mΩ	1,0 A	3,2 mm	1,6 mm	1,1 mm	1,0	SMT
<input type="checkbox"/> WE-CBF	High Current	1206										
<input type="checkbox"/> WE-CBF	High Current	1206										
<input type="checkbox"/> WE-CBF	High Current	1206										
<input type="checkbox"/> WE-CBF	High Speed	0603										
<input type="checkbox"/> WE-CBF	High Speed	0603										
<input type="checkbox"/> WE-CBF	Wide Band	0603										
<input type="checkbox"/> WE-CBF	Wide Band	0603										
<input type="checkbox"/> WE-CBF	High Current	0603										
<input type="checkbox"/> WE-CBF	High Current	0603										

Tip: Right-click with mouse on column-header for

add filter remove filter select all deselect all

Filter

Category

Impedance

Inductive Reactance

Resistance

Settings

maximum Ohm

minimum Ohm

frequency MHz

Impedance (Ohm)

Please select an item

Frequency (MHz)

Inductive Reactance

Please select an item

Frequency (MHz)

Resistance (Ω)

Please select an item

Frequency (MHz)



Component selector

File Tools Window Help

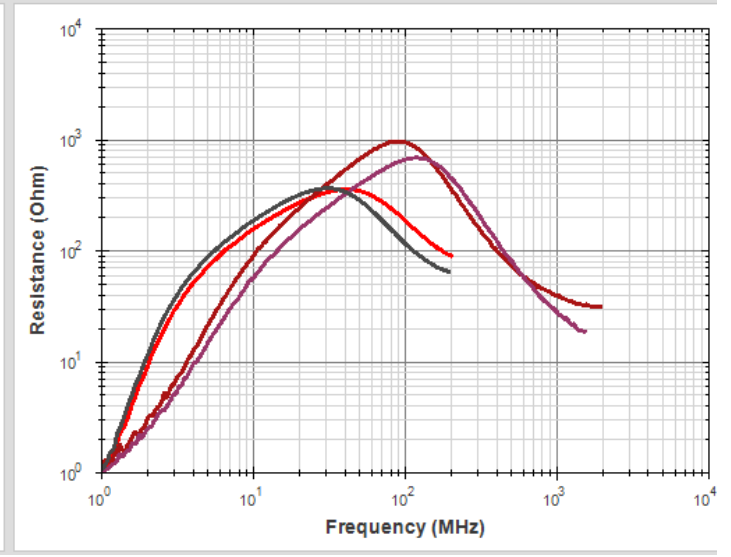
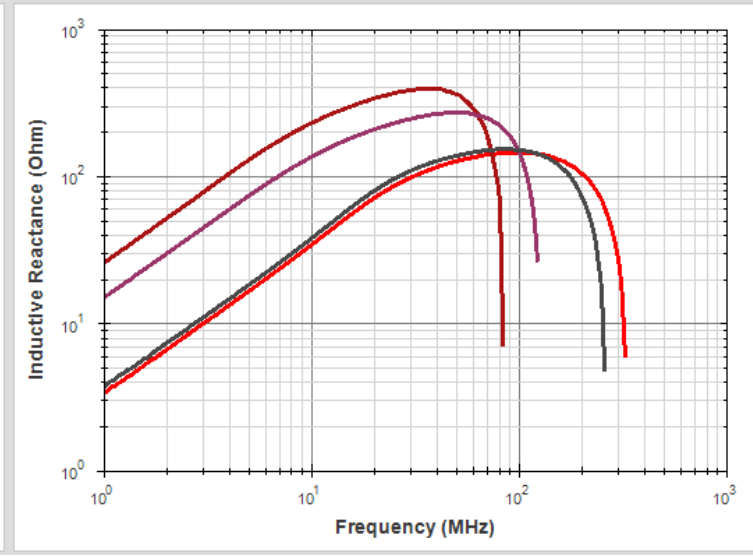
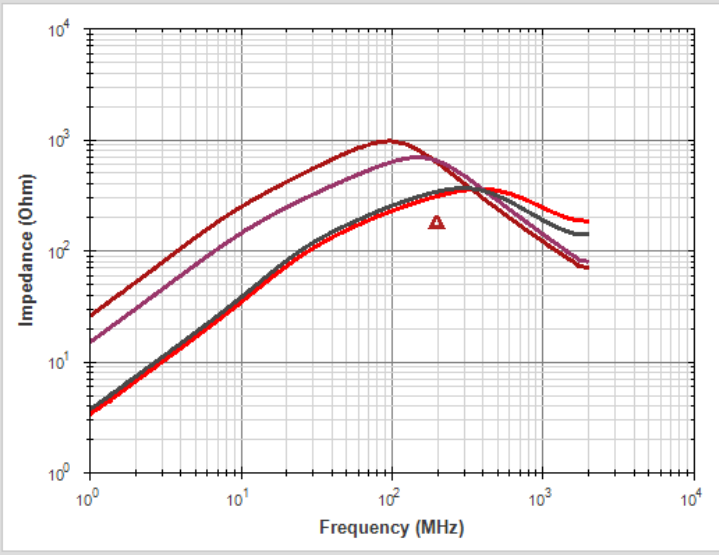
Parameter
 Source Impedance = 10 Ω
 Sink Impedance = 10 Ω
 Frequency = 200 MHz
 Attenuation = 20 dB
 Needed Impedance = 180 Ω

frequency minimum maximum
 Impedance
 200 MHz 180 Ohm -

Series	Type	Size	Order Code	Impedance @ Freq	Zmax @ Freq	RDC	IDC	Length	Width	Height	Lines	Assembling Technology	
<input checked="" type="checkbox"/>	WE-CBF	High Current	0805	742792022	220,0 Ω @ 100,0 MHz	330,0 Ω @ 300,0 MHz	50,0 mΩ	2,0 A	2,0 mm	1,3 mm	0,9 mm	1,0	SMT
<input type="checkbox"/>	WE-CBF	High Current	0805	742792031	300,0 Ω @ 100,0 MHz	350,0 Ω @ 200,0 MHz	50,0 mΩ	3,0 A	2,0 mm	1,3 mm	0,9 mm	1,0	SMT
<input type="checkbox"/>	WE-CBF	High Current	0805	742792037	330,0 Ω @ 100,0 MHz	375,0 Ω @ 250,0 MHz	80,0 mΩ	2,0 A	2,0 mm	1,3 mm	0,9 mm	1,0	SMT
<input type="checkbox"/>	WE-CBF	High Current	0805	742792040	600,0 Ω @ 100,0 MHz	700,0 Ω @ 150,0 MHz	150,0 mΩ	2,0 A	2,0 mm	1,3 mm	0,9 mm	1,0	SMT
<input checked="" type="checkbox"/>	WE-CBF	Wide Band	0805	7427920415	600,0 Ω @ 100,0 MHz	660,0 Ω @ 150,0 MHz	300,0 mΩ	500,0 mA	2,0 mm	1,3 mm	0,9 mm	1,0	SMT
<input type="checkbox"/>	WE-CBF	High Current	0805	742792096	1,0 kΩ @ 100,0 MHz	1,0 kΩ @ 100,0 MHz	300,0 mΩ	1,0 A	2,0 mm	1,3 mm	0,9 mm	1,0	SMT
<input type="checkbox"/>	WE-CBF	High Current	0805	742792097	1,5 kΩ @ 100,0 MHz	1,8 kΩ @ 70,0 MHz	300,0 mΩ	1,0 A	2,0 mm	1,3 mm	0,9 mm	1,0	SMT
<input type="checkbox"/>	WE-CBF	High Current	1206	742792116	500,0 Ω @ 100,0 MHz	610,0 Ω @ 150,0 MHz	60,0 mΩ	2,5 A	3,2 mm	1,6 mm	1,1 mm	1,0	SMT
<input type="checkbox"/>	WE-CBF	High Current	1206	742792121	300,0 Ω @ 100,0 MHz	330,0 Ω @ 110,0 MHz	60,0 mΩ	3,0 A	3,2 mm	1,6 mm	1,1 mm	1,0	SMT
<input checked="" type="checkbox"/>	WE-CBF	High Current	1206	742792141	1,0 kΩ @ 100,0 MHz	1,1 kΩ @ 90,0 MHz	300,0 mΩ	1,0 A	3,2 mm	1,6 mm	1,1 mm	1,0	SMT
<input type="checkbox"/>	WE-CBF	High Current	1206	74279218	600,0 Ω @ 100,0 MHz	700,0 Ω @ 90,0 MHz	100,0 mΩ	2,0 A	3,2 mm	1,6 mm	1,1 mm	1,0	SMT
<input type="checkbox"/>	WE-CBF	High Current	1206	742792118	600,0 Ω @ 100,0 MHz	650,0 Ω @ 80,0 MHz	70,0 mΩ	2,5 A	3,2 mm	1,6 mm	1,1 mm	1,0	SMT
<input type="checkbox"/>	WE-CBF	High Speed	1206	742792133	600,0 Ω @ 100,0 MHz	750,0 Ω @ 60,0 MHz	300,0 mΩ	500,0 mA	3,2 mm	1,6 mm	1,1 mm	1,0	SMT
<input type="checkbox"/>	WE-CBF	High Speed	0603	742792621	140,0 Ω @ 100,0 MHz	430,0 Ω @ 550,0 MHz	200,0 mΩ	1,6 mm	0,8 mm	0,8 mm	1,0	SMT	
<input type="checkbox"/>	WE-CBF	Wide Band	0603	742792622	180,0 Ω @ 100,0 MHz	290,0 Ω @ 380,0 MHz	300,0 mΩ	500,0 mA	1,6 mm	0,8 mm	0,8 mm	1,0	SMT
<input checked="" type="checkbox"/>	WE-CBF	Wide Band	0603	74279263	220,0 Ω @ 100,0 MHz	280,0 Ω @ 350,0 MHz	300,0 mΩ	500,0 mA	1,6 mm	0,8 mm	0,8 mm	1,0	SMT
<input type="checkbox"/>	WE-CBF	High Current	0603	742792641	300,0 Ω @ 100,0 MHz	450,0 Ω @ 250,0 MHz	150,0 mΩ	2,0 A	1,6 mm	0,8 mm	0,8 mm	1,0	SMT
<input type="checkbox"/>	WE-CBF	High Current	0603	742792651	600,0 Ω @ 100,0 MHz	800,0 Ω @ 200,0 MHz	200,0 mΩ	1,0 A	1,6 mm	0,8 mm	0,8 mm	1,0	SMT

Tip: Right-click with mouse on column-header for filtering components.

add filter remove filter select all deselect all add own Frequency

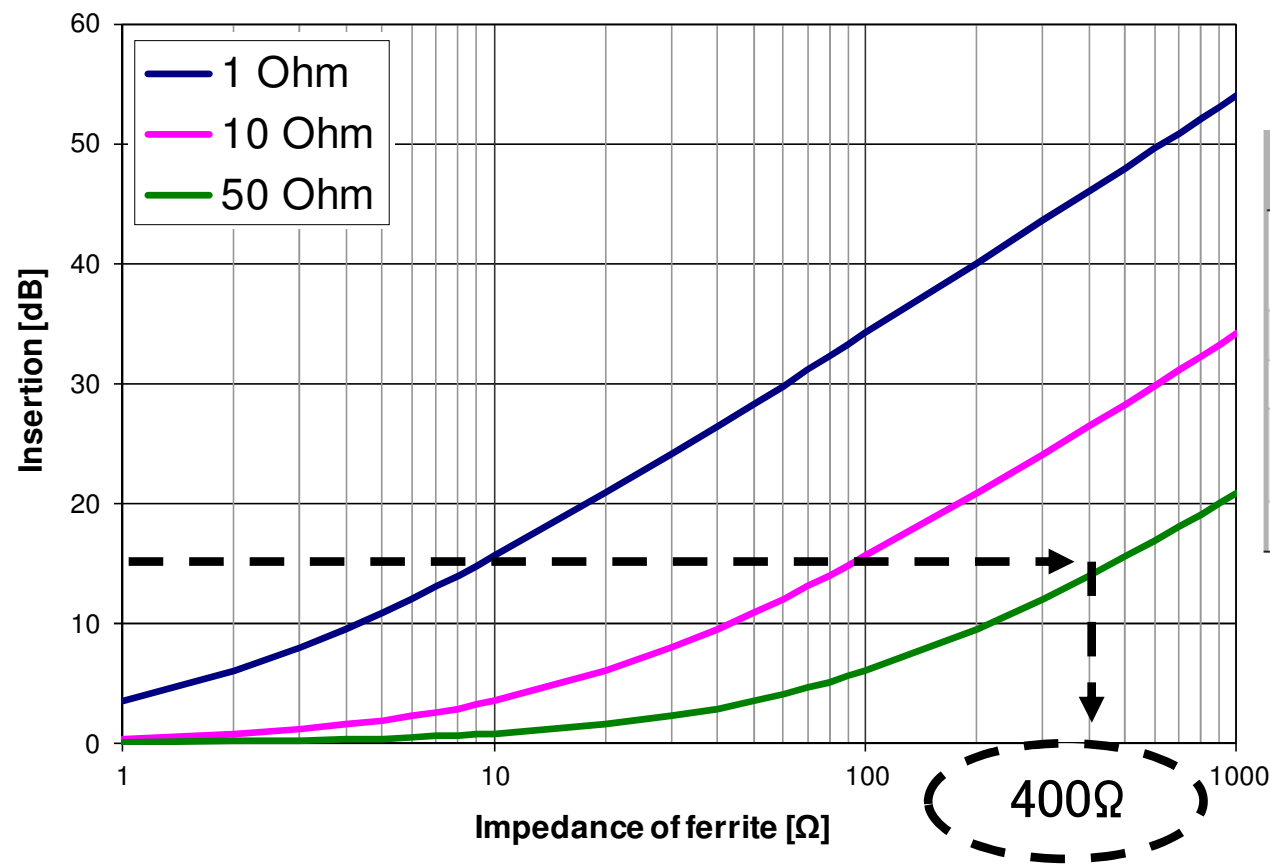




Insertion loss - example

→ Application: sensor line, cable diameter 5mm

→ 15dB @ 200 MHz



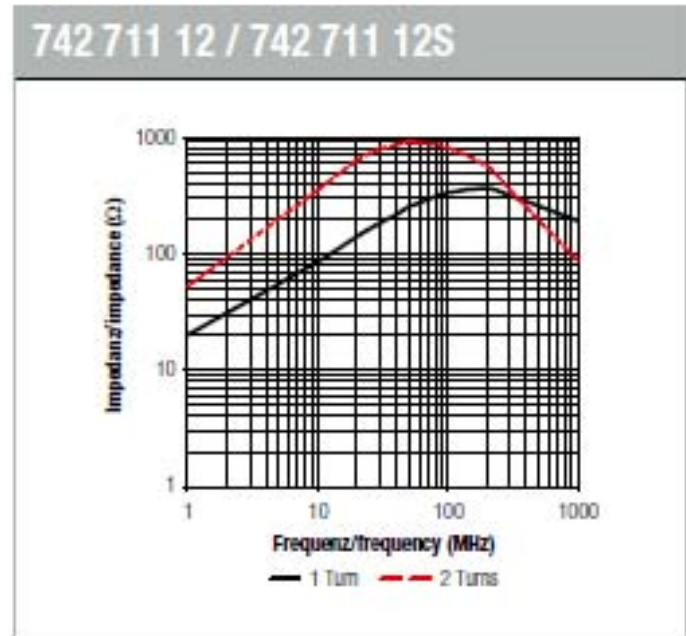
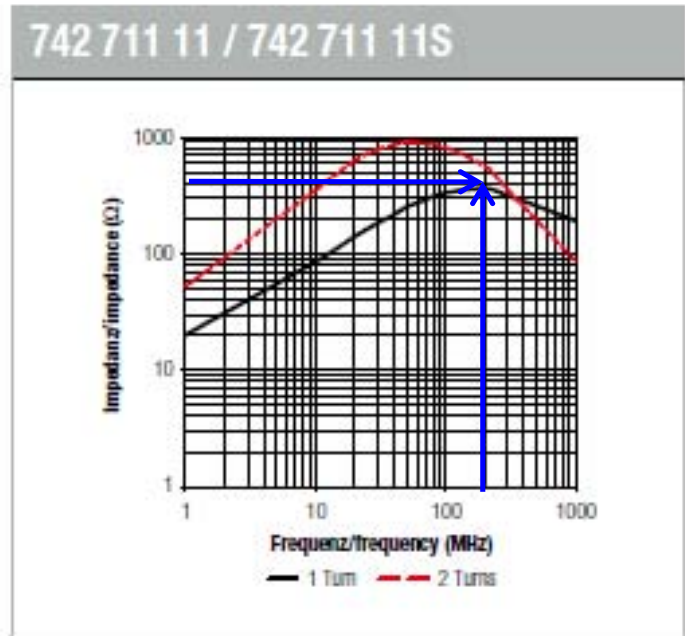
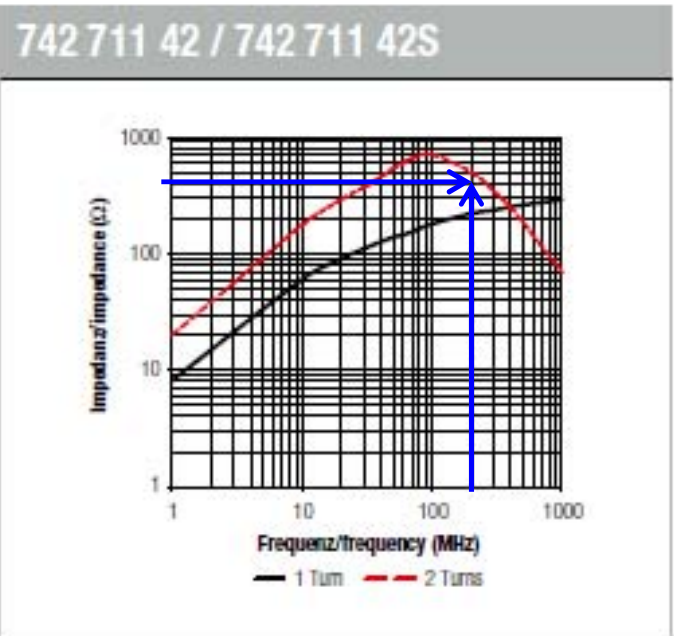
Application overview	
Assumend practical system impedance	Application
1 Ω	GND (Ground Planes)
10 Ω	V _{cc} (Supply Voltage lines)
50 Ω – 90 Ω	Datasignal Lines/Clock/Video Signal/USB
90 Ω – 150 Ω	Long Datasignal Lines

- System impedance = 50 Ω

Star-Tec

Electrical properties

Order Code	A (mm)	B (mm)	C (mm)	Colour	Z @ 25 MHz (Ω) 1 Turn	Z @ 100 MHz (Ω) 1 Turn	Z @ 25 MHz (Ω) 2 Turns	Z @ 100 MHz (Ω) 2 Turns	Cable Ø (mm)	Material	Order Code Fixation
742 711 42	32.5	18.8	13.2	grey	98	182	401	709	3.5–5.0		–
742 711 42S	32.5	18.8	13.2	black	98	182	401	709	3.5–5.0		–
742 711 11*	40.5	23.7	18.2	grey	175	320	770	800	3.5–5.0		742 771 1
742 711 11S*	40.5	23.7	18.2	black	175	320	770	800	3.5–5.0		742 771 1
742 711 12*	40.5	23.7	18.2	grey	176	321	773	806	4.5–6.0		742 771 1

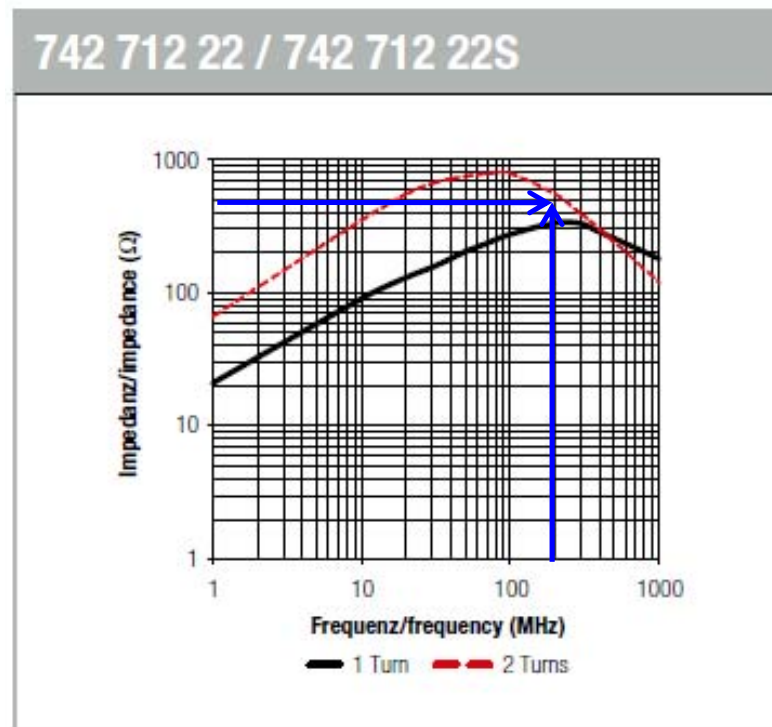


Star-Tec



Electrical properties

Order Code	A (mm)	B (mm)	C (mm)	Colour	Z @ 25 MHz (Ω) 1 Turn	Z @ 100 MHz (Ω) 1 Turn	Z @ 25 MHz (Ω) 2 Turns	Z @ 100 MHz (Ω) 2 Turns	Cable Ø (mm)	Material	Order Code Fixation
742 712 22	42.2	33.5	28.8	grey	145	265	638	779	10.5–12.5		–
742 712 22S	42.2	33.5	28.8	black	145	265	638	779	10.5–12.5		–

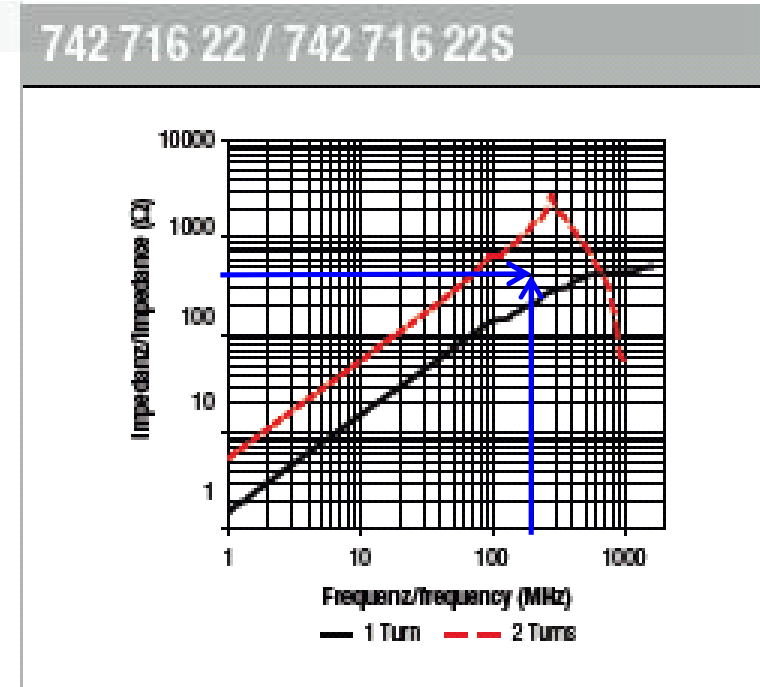
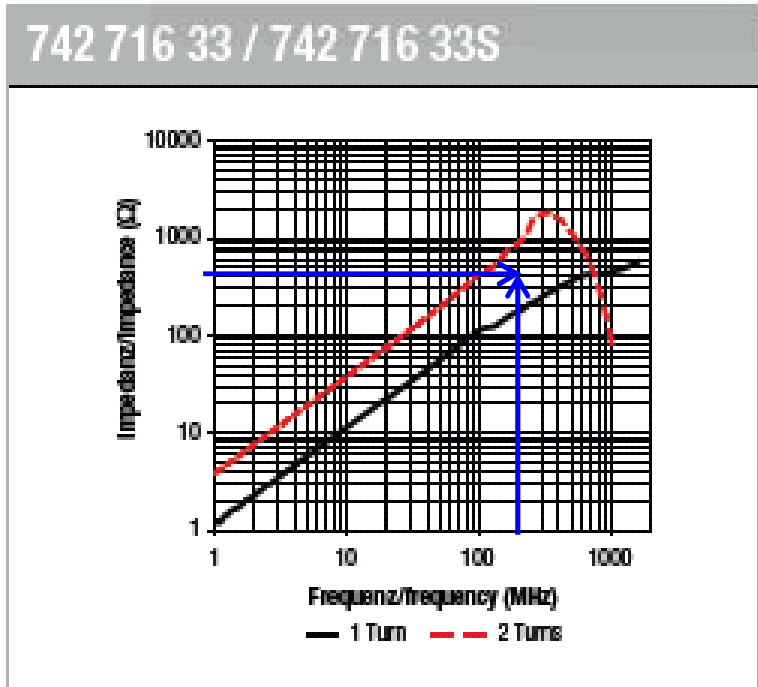


Star-Gap



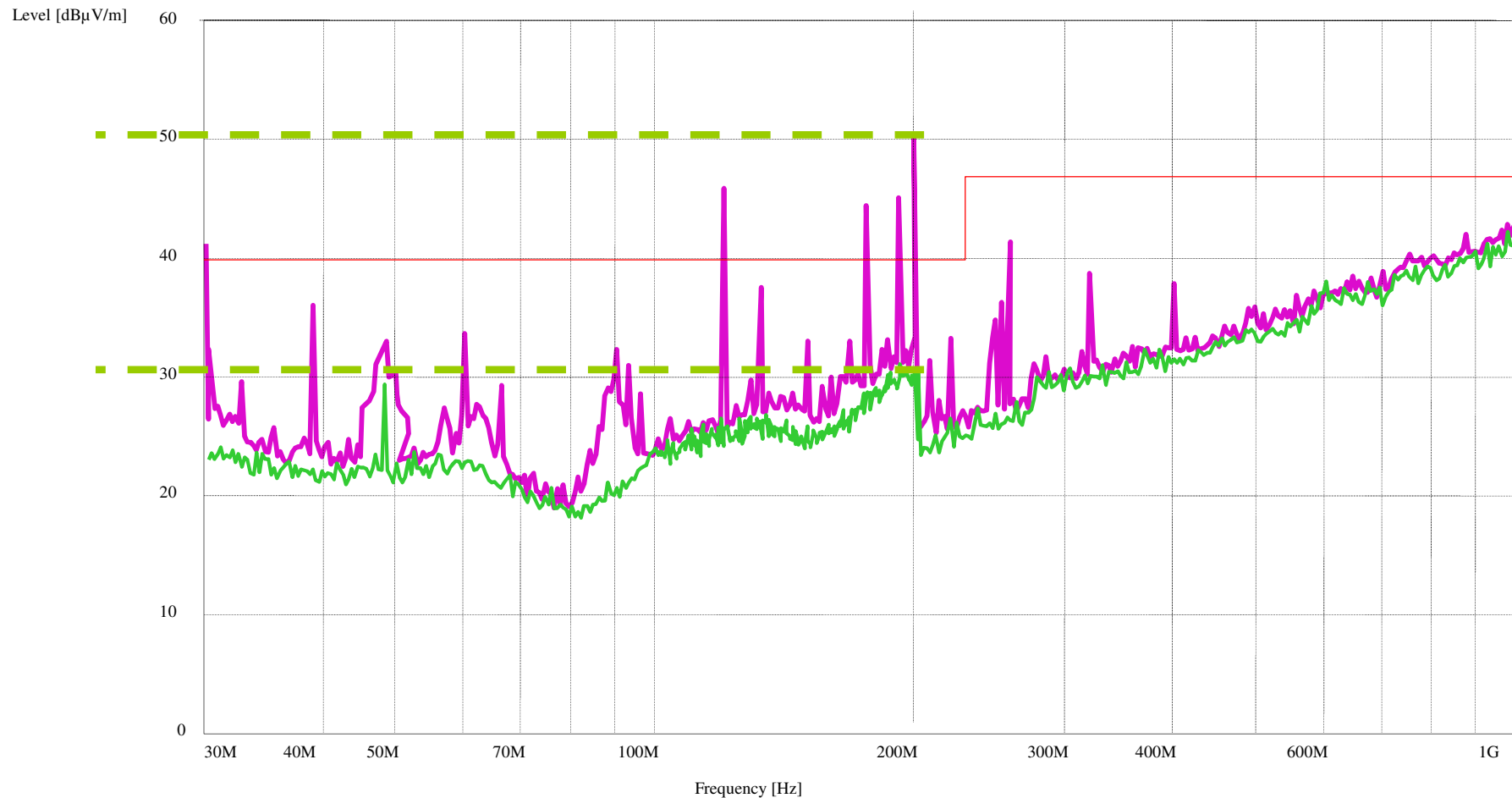
Electrical properties

Order Code	A (mm)	B (mm)	C (mm)	Colour	Z @	Z @	Z @	Z @	Z @	Z @	Z @	Z @	Z @	Z @	Cable Ø (mm)	Material	Order Code Fixation
					25 MHz (Ω) 1 Turn	100 MHz (Ω) 1 Turn	200 MHz (Ω) 1 Turn	300 MHz (Ω) 1 Turn	500 MHz (Ω) 1 Turn	25 MHz (Ω) 2 Turns	100 MHz (Ω) 2 Turns	200 MHz (Ω) 2 Turns	300 MHz (Ω) 2 Turns	500 MHz (Ω) 2 Turns			
742 716 33*	35.1	21.7	19.0	grey	28	100	190	250	345	90	400	900	1750	1100	4 W 620		742 771 1
742 716 33S*	35.1	21.7	19.0	black	28	100	190	250	345	90	400	900	1750	1100			742 771 1
742 716 22	35.0	31.5	28.3	grey	35	140	200	300	400	135	640	1400	1900	830	8.5–12.5		-
742 716 22S	35.0	31.5	28.3	black	35	140	200	300	400	135	640	1400	1900	830			8.5–12.5



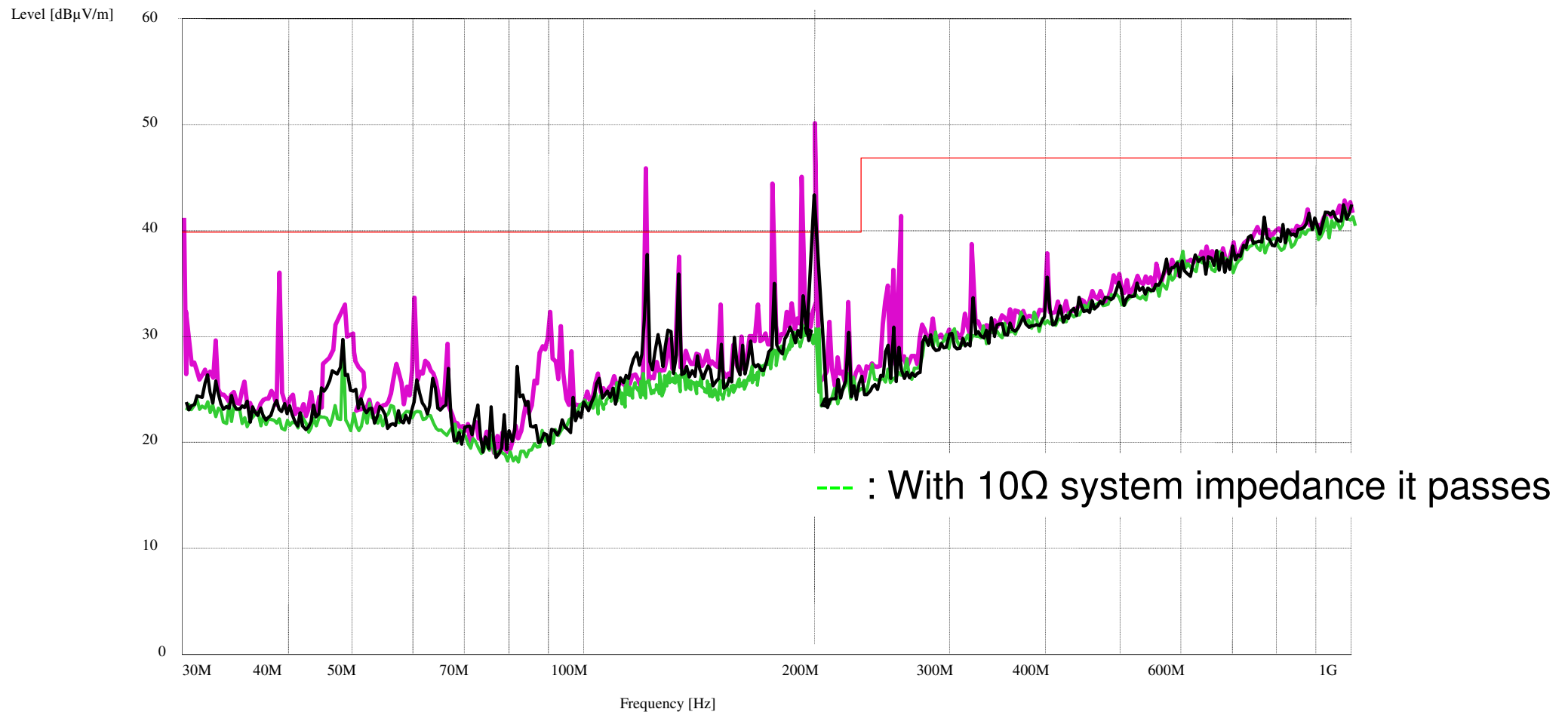
Insertion loss – Example

- Check the results
 - Measuring the emission and compare the attenuation



Insertion loss – Example

- Choosing different system impedance





DESIGN GUIDES

Trilogy of Magnetics

- Now published as 4th edition

- Three sections:

 - **Magnetic basics**

 - **Components**

 - **Application notes**

 - **Filtering**

 - **DC/DC PSU design**



THANK YOU



Any Questions?

